Demonstration of Subsurface Containment System for Installation of Barriers

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Abstract

INTRODUCTION: DOE landfills contain more than 3 million cubic meters of buried waste that have special cleanup needs. The Cold War legacy and disposal practices used decades ago left these landfills and other trenches, pits, and disposal sites filled with materials that are becoming detrimental to human safety and health. Today's cleanup and waste removal is time-consuming and expensive, with some sites scheduled to complete cleanup by 2006 or later. Environmental remediation schedules are currently being met. The installation of containment barriers will isolate buried waste and protect groundwater from pollutants until final remediations are completed.

The Department of Energy (DOE) has awarded a contract to RAHCO International, Inc., of Spokane, Washington to design, develop, and test a novel barrier installation system to protect soil and groundwater from contamination and effectively meet environmental cleanup standards while reducing schedules, risks, and costs.

RAHCO International and IT Corporation, a company with offices near Oak Ridge and headquarters in Pittsburgh, will install test barriers around trenches to surround and encapsulate drums, chemicals, and other waste to prevent pollution from spreading into soil and groundwater until the area can be remediated.

The new system consists of underground barriers made of concrete and a special liner that forms a continuous layer of nearly impermeable material to isolate underground waste, similar to the way a swimming pool holds water, without disrupting hazardous material that was buried decades ago.

The objectives of the Phase I Pilot-Scale Field Test are:

- Evaluate installation process used to create the subsurface containment barrier.
- Validate installed barrier construction materials and structure.
- Validate functional barrier performance.

The Phase II Full-Scale Demonstration objectives include:

- Demonstrate installation process under site-specific technology performance requirements and regulatory requirements.
- Validate functional barrier performance.
- Perform long-term monitoring.

SYSTEM DESCRIPTION: The Subsurface Containment System (SCS) provides both the construction process and the resulting containment barrier. This system uses conventional construction equipment including backhoe excavators and shoring boxes to excavate side and end trenches and a mobile crane to install prefabricated trench barriers. These trenches provide access for a remote-controlled Slot Barrier Placement Machine (SBPM) capable of excavating up to a 100-ft-wide, horizontal slot beneath a waste area while simultaneously installing a 1-ft-thick, prefabricated slot barrier. Previous proof-of-principle tests conducted successfully by RAHCO are used as a foundation for this demonstration process.

The equipment and materials used to construct the subsurface barriers include:

1. Conventional construction equipment including a backhoe excavator, shoring system, and mobile crane used to excavate the vertical perimeter trenches and install the trench barrier.

2. A specialized slot barrier placement machine used to excavate a 1-ft-thick, horizontal slot below the waste area and install a nearly impermeable, continuous, slot barrier.

3. The containment barriers include the precast concrete trench and slot barrier structures covered with geomembrane.

During operation, verification of the continuity of the containment barrier will be accomplished using a variety o inspection techniques.

MERIT OF TECHNOLOGY: The SCS System offers DOE a unique, proven, technology to protect soil and groundwater from contamination. Specifically, the merits are:

- **Breadth of Application:** It can be used at sites throughout the DOE complex and can accommodate varying waste area configurations of up to 100-ft wide and 40-ft deep and geological conditions from clays and mixed rock to 40,000-psi compressive strength.

- **State-of-the-Art Technology:** Equipment and components have been selected to minimize the risk of failure and to ensure success. The barrier installation system uses conventional equipment and proven construction techniques and materials.

- **Reduces Risk to Workers & the Public:** By reducing the number of workers involved and their contact with the equipment and waste materials, there is reduced risk of contamination. Similarly, this system greatly minimizes the potential for airborne release and groundwater contamination.

- **Reduces Remediation Time:** The system is highly mobile and rapidly deployable. It provides construction speeds to 10 lineal ft per single shift operation with construction times that cannot be achieved by other methods.

- **Reduces Environmental Impacts:** The SCS incorporates design features including secondary containment to ensure against any leakage of operating fluids, a vacuum-type air cleaning system with HEPA filters, and surface water runoff and groundwater containment.

- **Meets Regulatory Requirements:** The equipment and construction methods comply with applicable

codes and federal regulations.

- **Reduces Cost:** The current costs to remove, process, and store buried wastes are estimated at as much as $5000/cu yd, assuming a nominal 30-ft-wide by 25-ft-deep waste area, 1000 ft in length. The overall unit cost for the SCS barrier is estimated at approximately $340/cu yd of waste volume.

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Industry Partnerships
for
Environmental Science and Technology Conference
Morgantown, West Virginia
31 October 2001

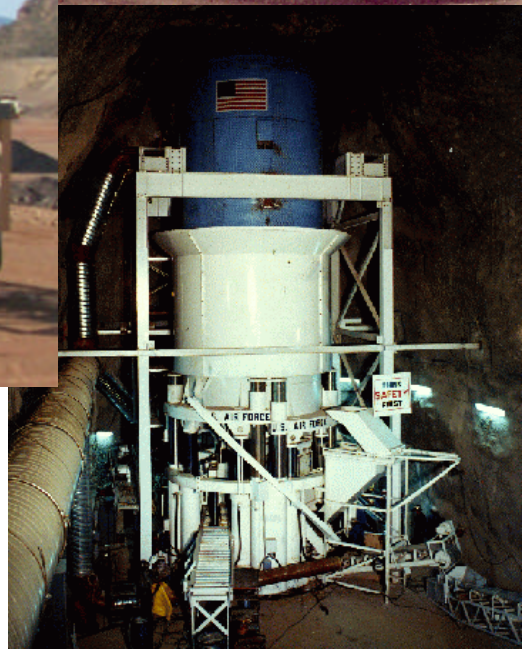
RAHCO International, Inc.
Spokane, Washington

Agenda

- INTRODUCTION
- BURIED WASTE PROBLEM/SOLUTION
- SCS DESCRIPTION
- TEST RESULTS
- BENEFITS

RAHCO International, Inc.

SUBSURFACE CONTAMINANTS FOCUS AREA



Subsurface Containment System (SCS)

Project Manager:	Gregory Barber, RAHCO International, Inc.
Principal Investigator:	Thomas Crocker, RAHCO International, Inc.
Subcontractors:	IT Corporation Excavation Engineering Associates, Inc. Construction & Tunneling Services, Inc.
NETL Program Manager:	Karen Cohen
SCFA Containment Product Line Integrator:	Michael Serrato
Phase I Project Duration:	September 1999-November 2001

What is the Problem?

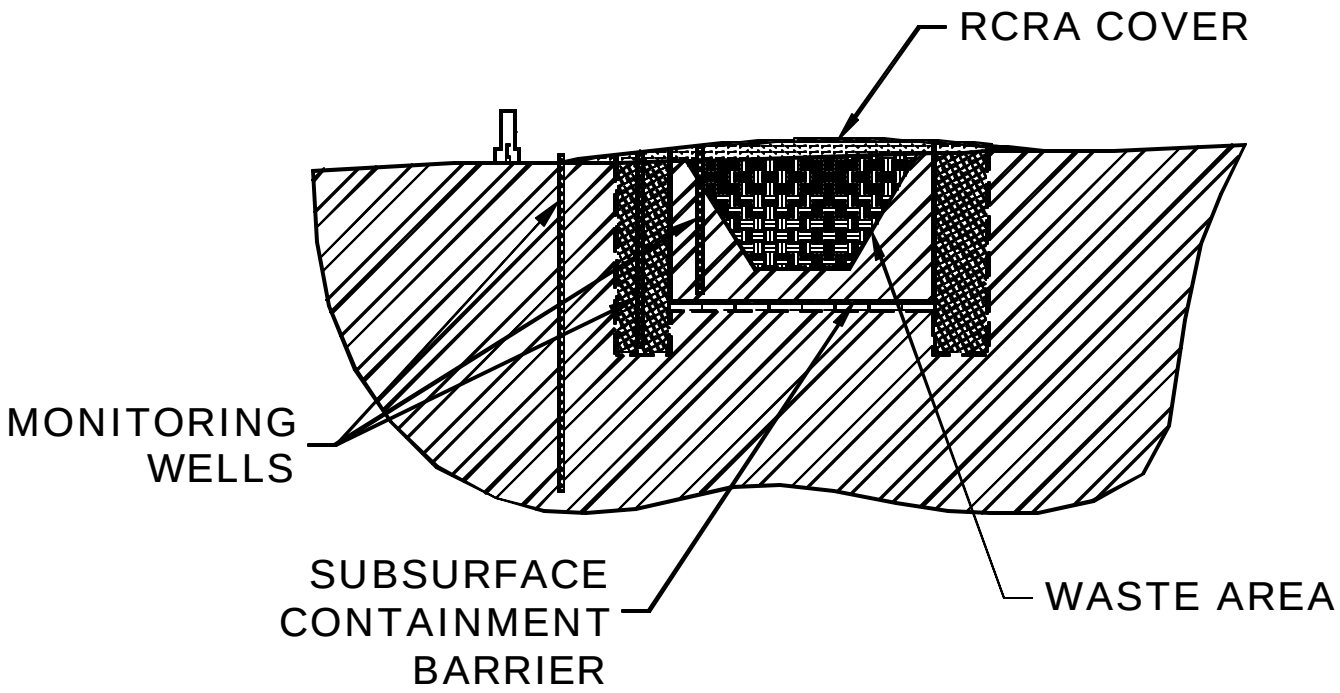
2 Between 1952 and 1970, DOE buried mixed waste in pits and trenches.

Oak Ridge Bear Creek Valley Burial Grounds

! Three million cubic meters of buried waste are becoming harmful to human safety and health.

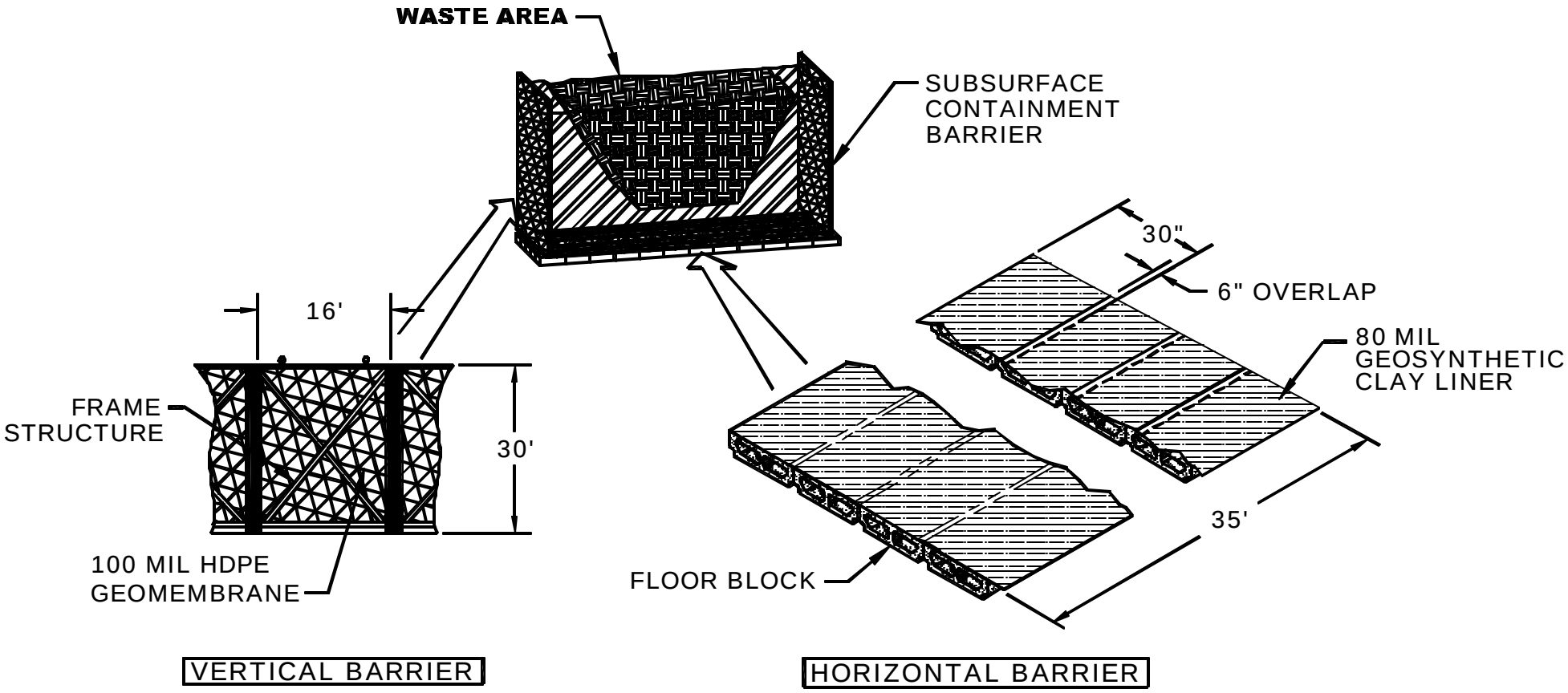
RAHCO's Proposed Solution

2 Surround the waste with a nearly impermeable barrier and monitor the performance of the barrier over its lifespan.



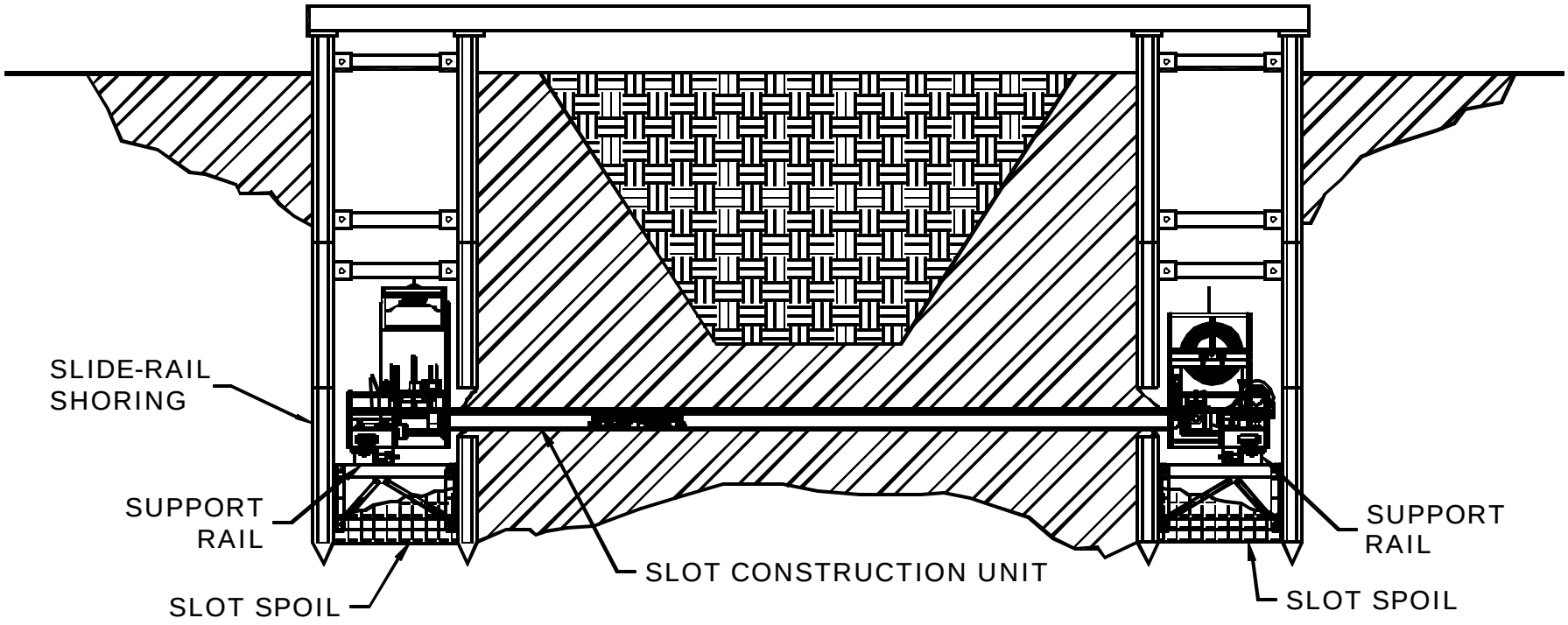
! Construct the subsurface containment barrier using the RAHCO-developed Subsurface Containment System (SCS).

Subsurface Containment Barrier



SCS CONSTRUCTION METHOD

SUBSURFACE CONTAMINANTS FOCUS AREA



- Conventional & Specialized Equipment
- State-of-the-Art Construction Materials
- Unique Construction Process

CONSTRUCTION EQUIPMENT

SUBSURFACE CONTAMINANTS FOCUS AREA

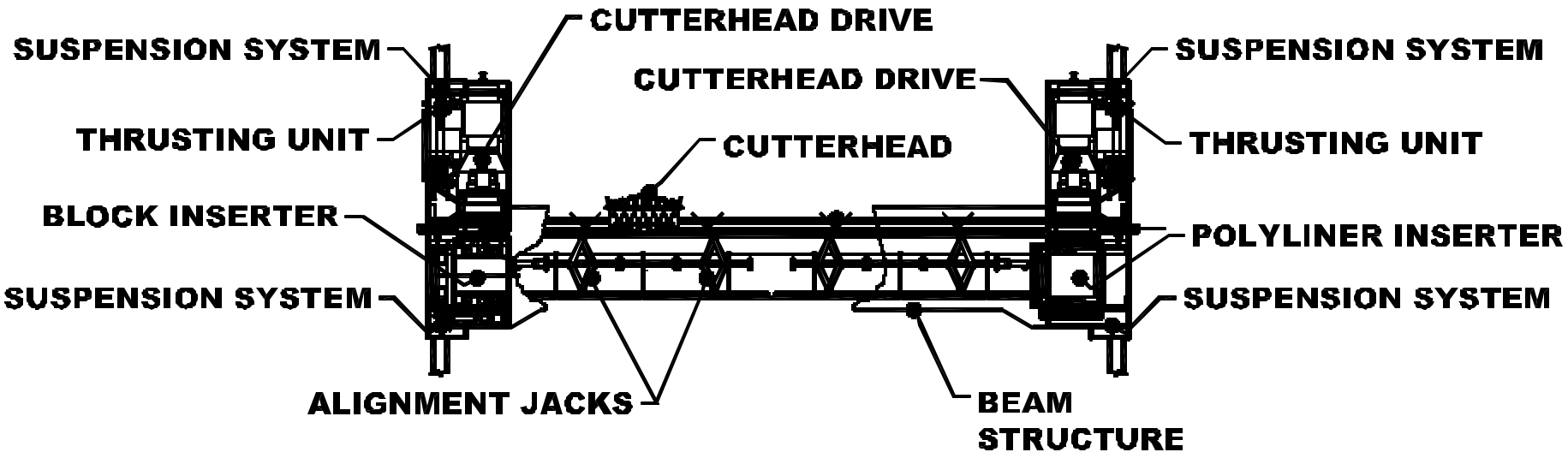
Conventional Equipment

- Backhoe Excavator
- End Effectors
- Front End Loader
- 100-ton Crane
- 25-ton Mobile Crane
- Flat Bed Truck
- Geomembrane Joint Welder

Specialized Equipment

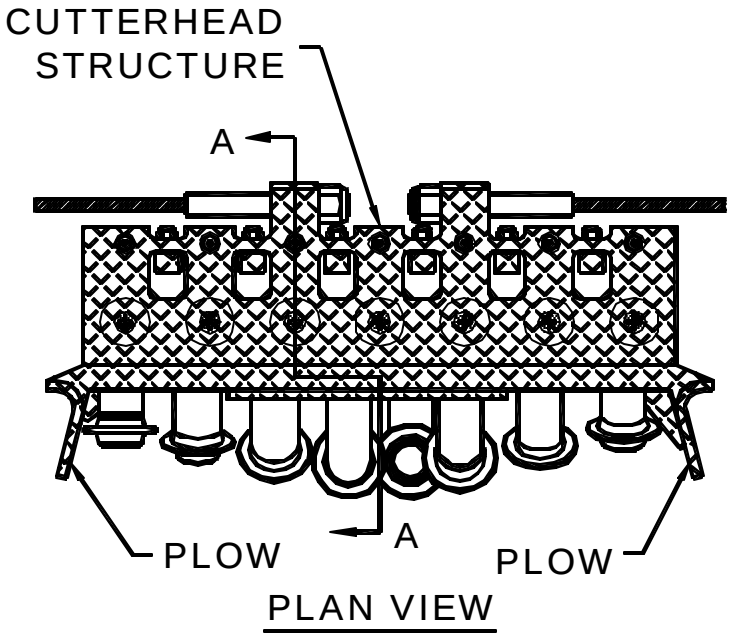
- Modular Slide-Rail Shoring System
- Slot Construction Unit
- Power & Control Unit

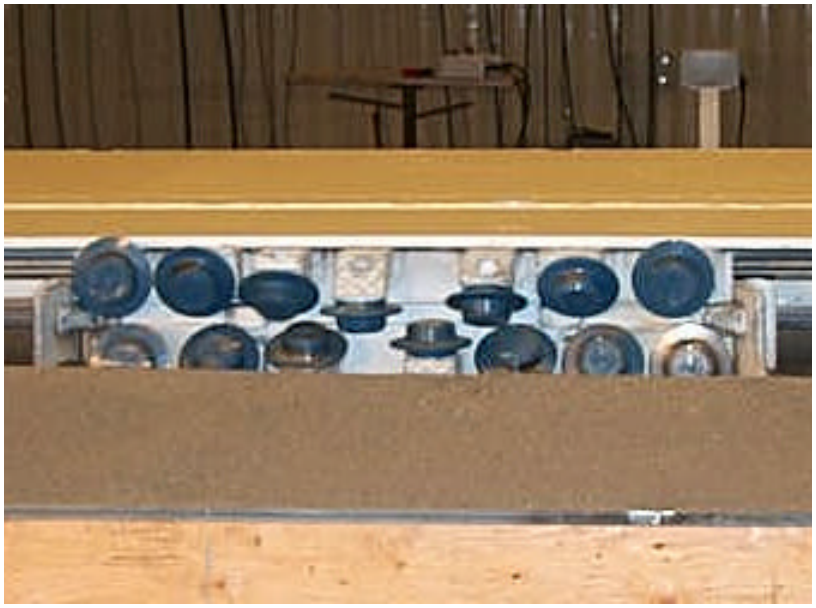
Slot Construction Unit

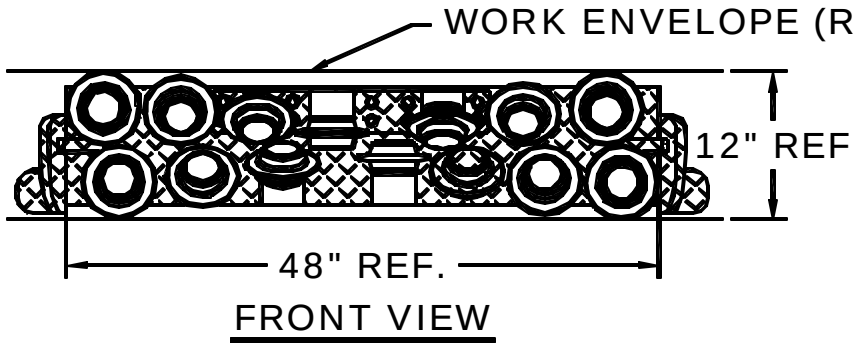


- 53 ft Wide x 16 ft Long X 10 ft High
- Approximately 90,000 lbs
- Seven Major Subassemblies
- All Electric
- Remotely Operated

Cutterhead

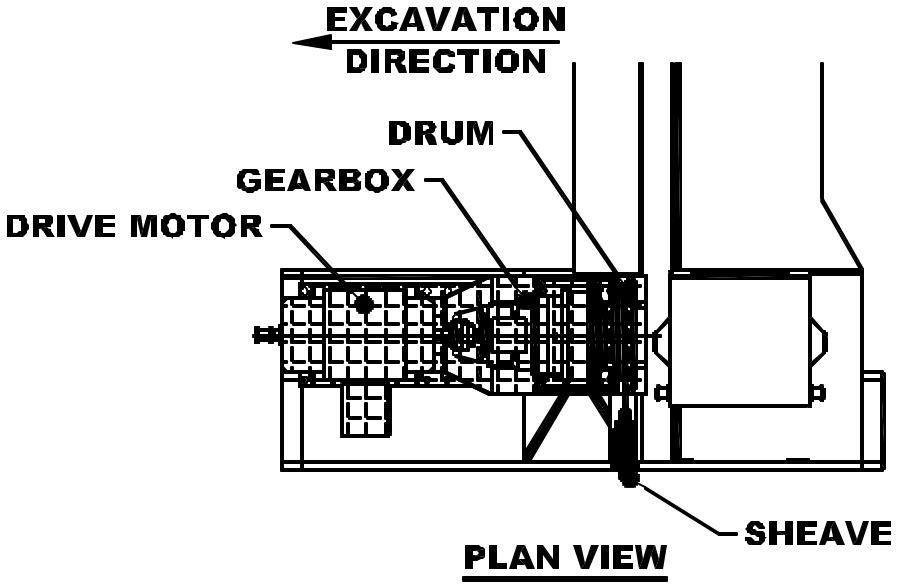


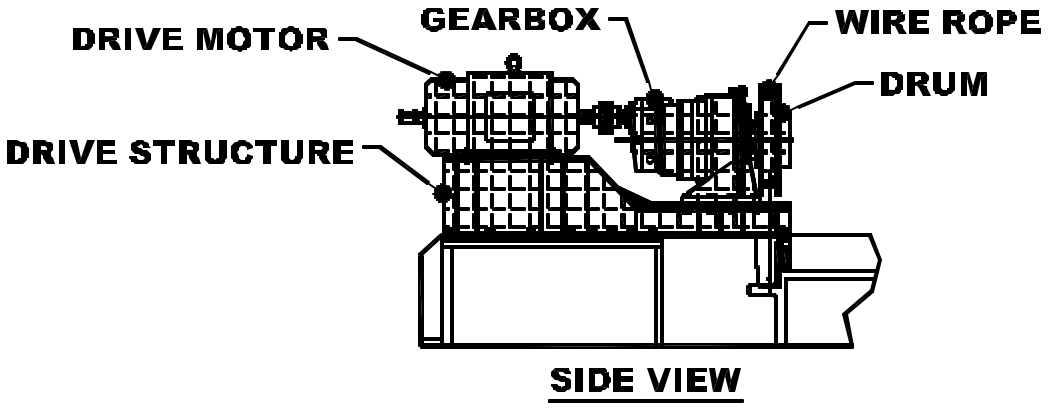


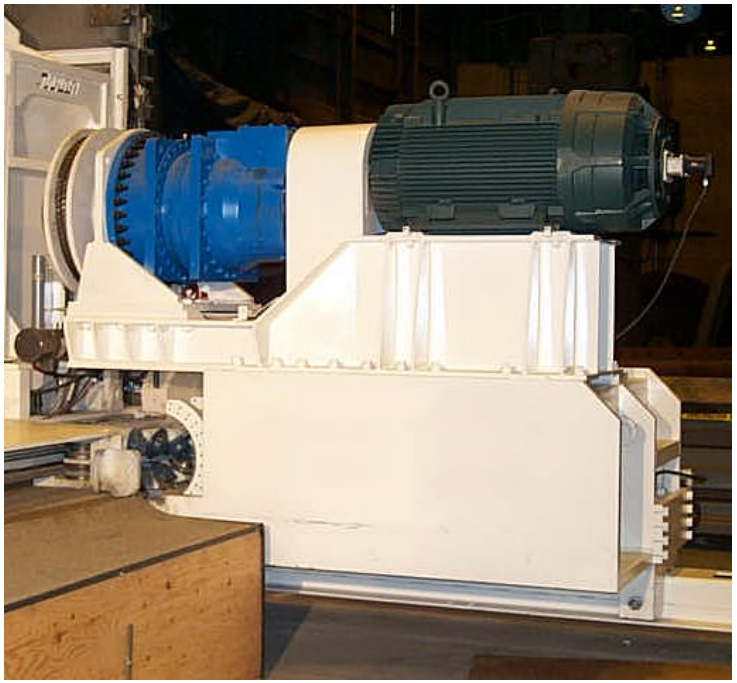


- 14, 6-in.-diameter Roller Disc Cutters
- 210,000 lbs Cutter Thrust
- Passive Muck Removal
- Adjustable Cutters

Cutterhead Drive

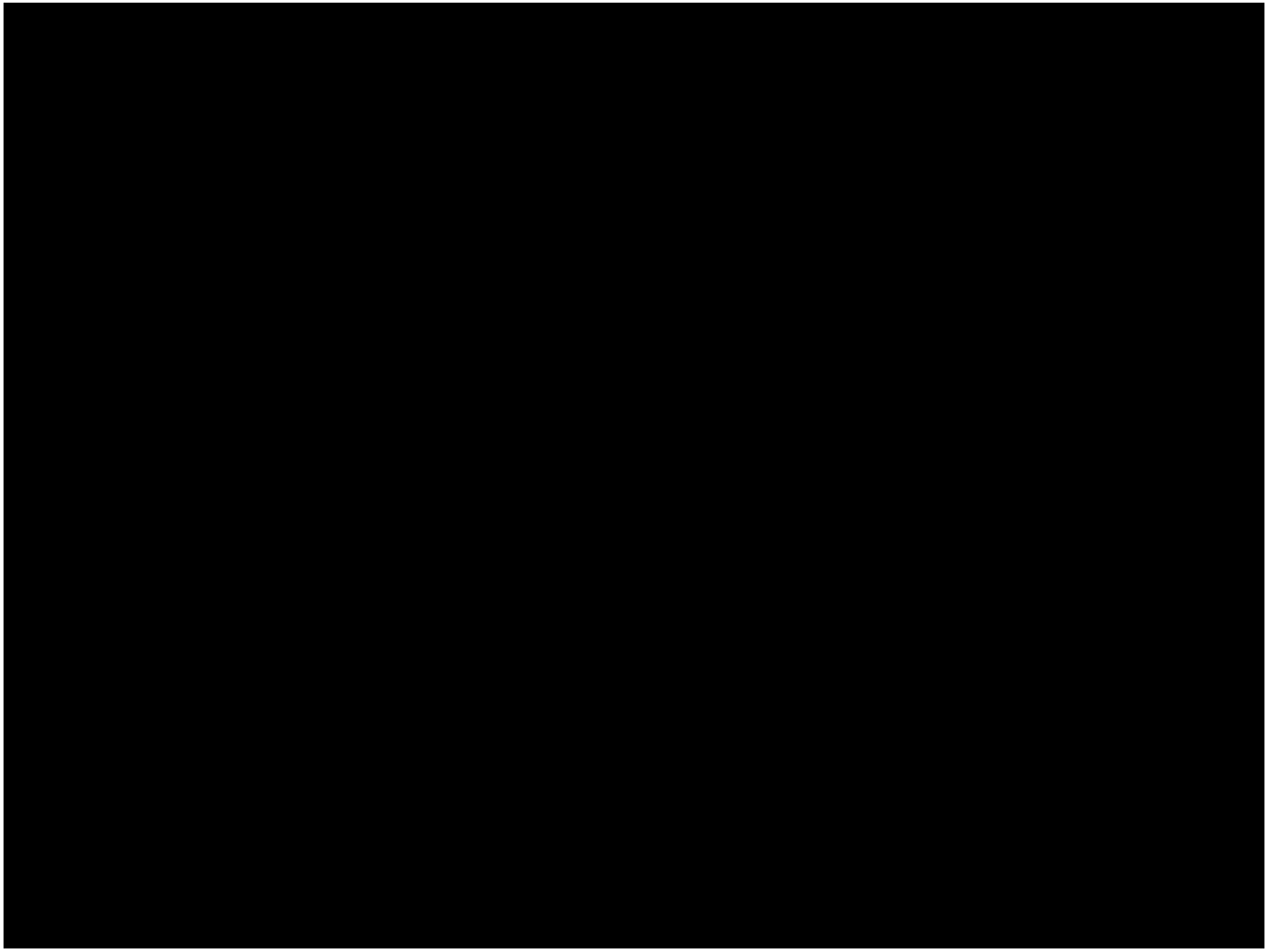




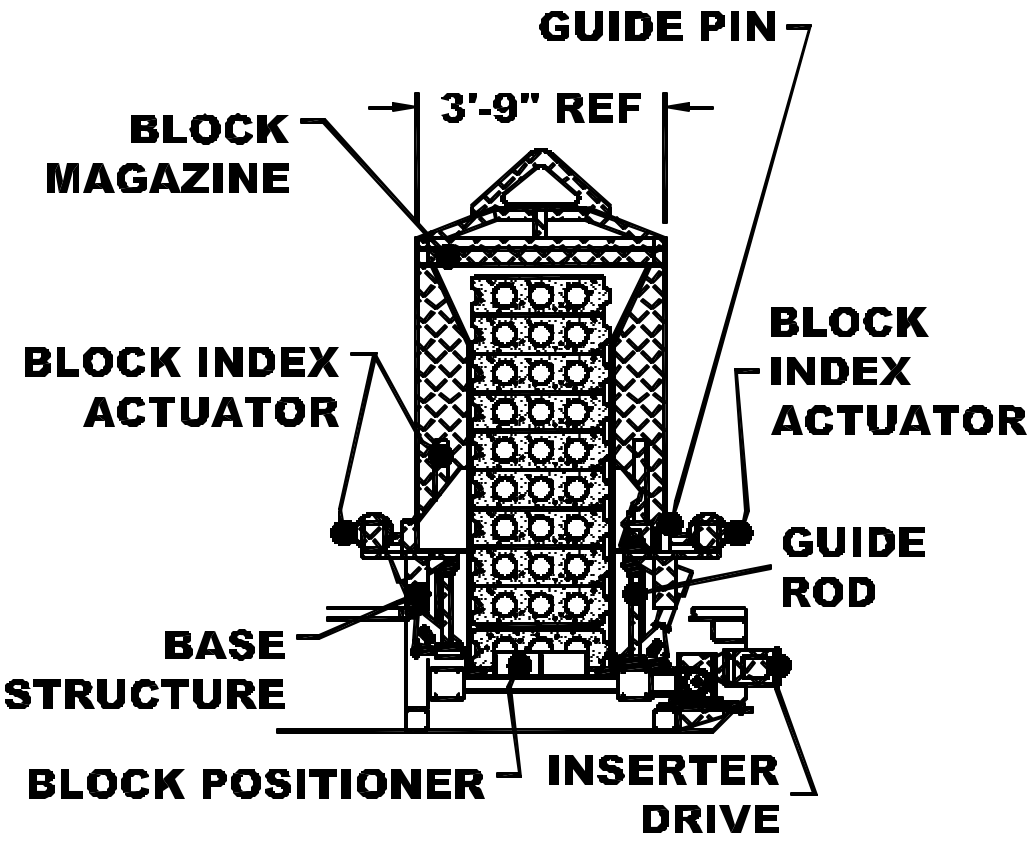


- 400 hp
- 24-in.-diameter Winch
- 140,000 lbs Pulling Force
- 200 fpm Travel Speed (max)
- Cut-Index Autosequence

Excavate Slot



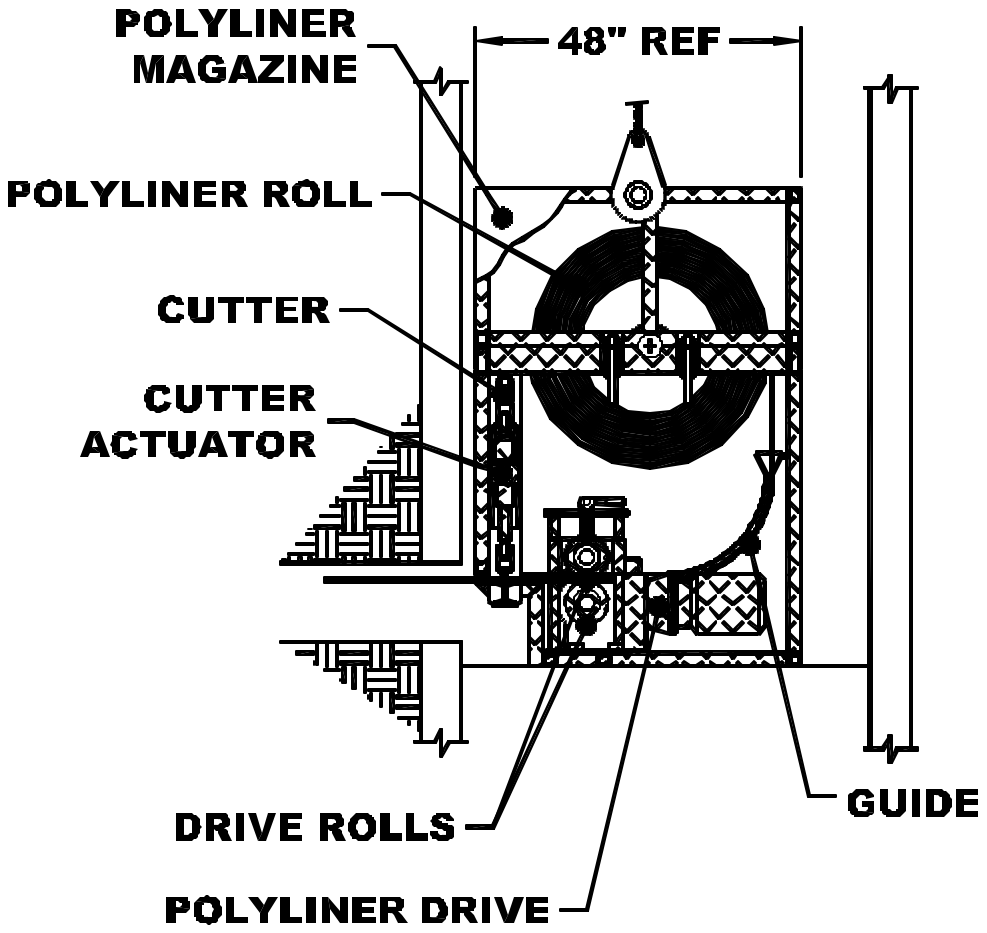
Block Inserter



- 11-Block Capacity
- 38-in. Push Stroke
- 5-hp Electrical-Mechanical Drive
- Block Insert Autosequence

Insert Block

Polyliner Inserter

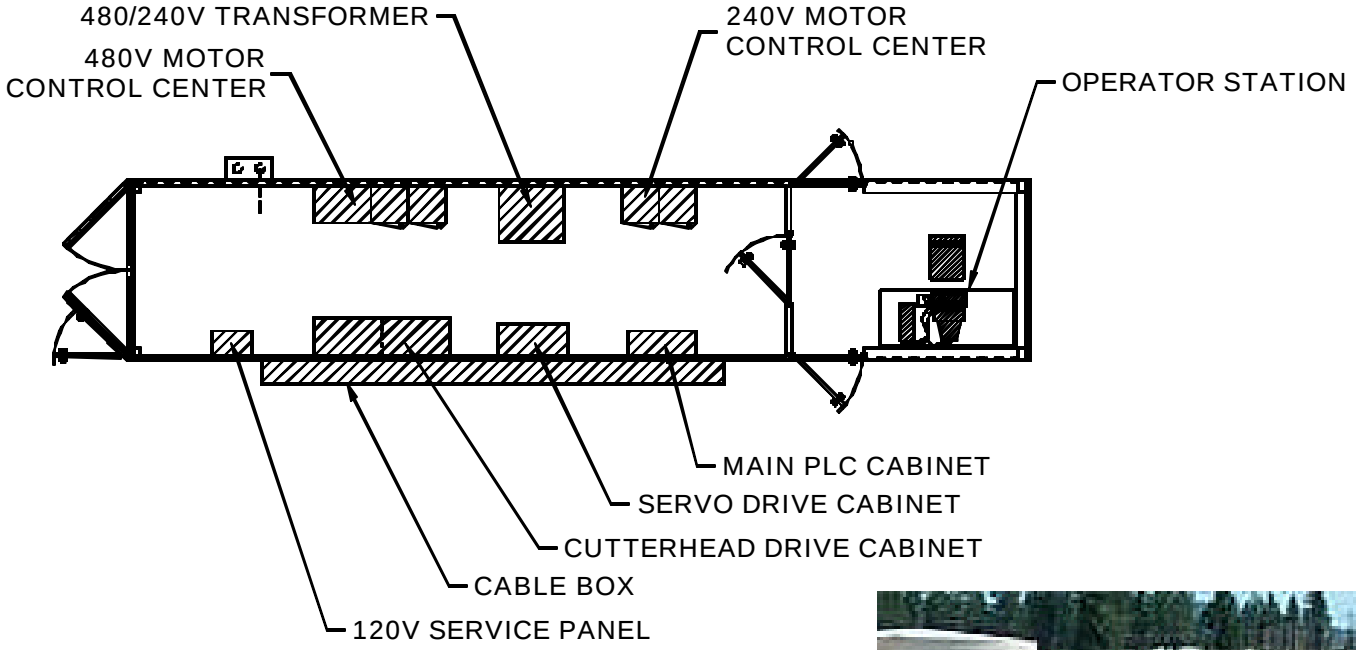


ELEVATION VIEW

- 150-ft Polyliner Roll
- Mechanical Shear
- 5-hp Electric Drive
- Polyliner Insert Autosequence

Insert Polyliner

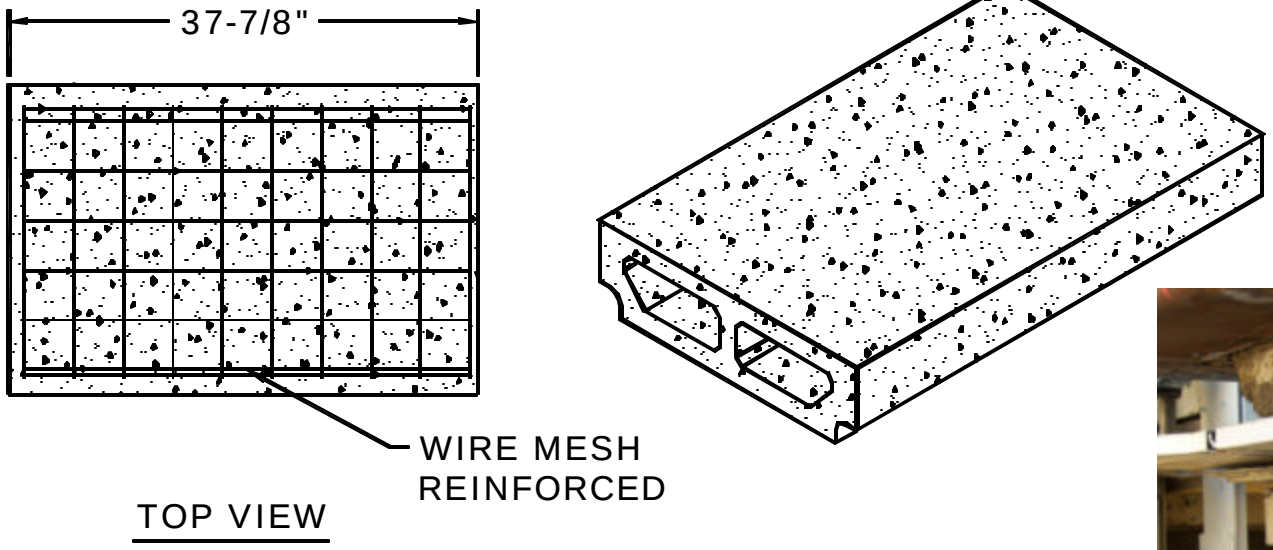
Power & Control Unit



- 40-ft Long X 10-ft Wide X 8-ft High
- Motor Control Center
- Operator Station
- Air-Conditioned

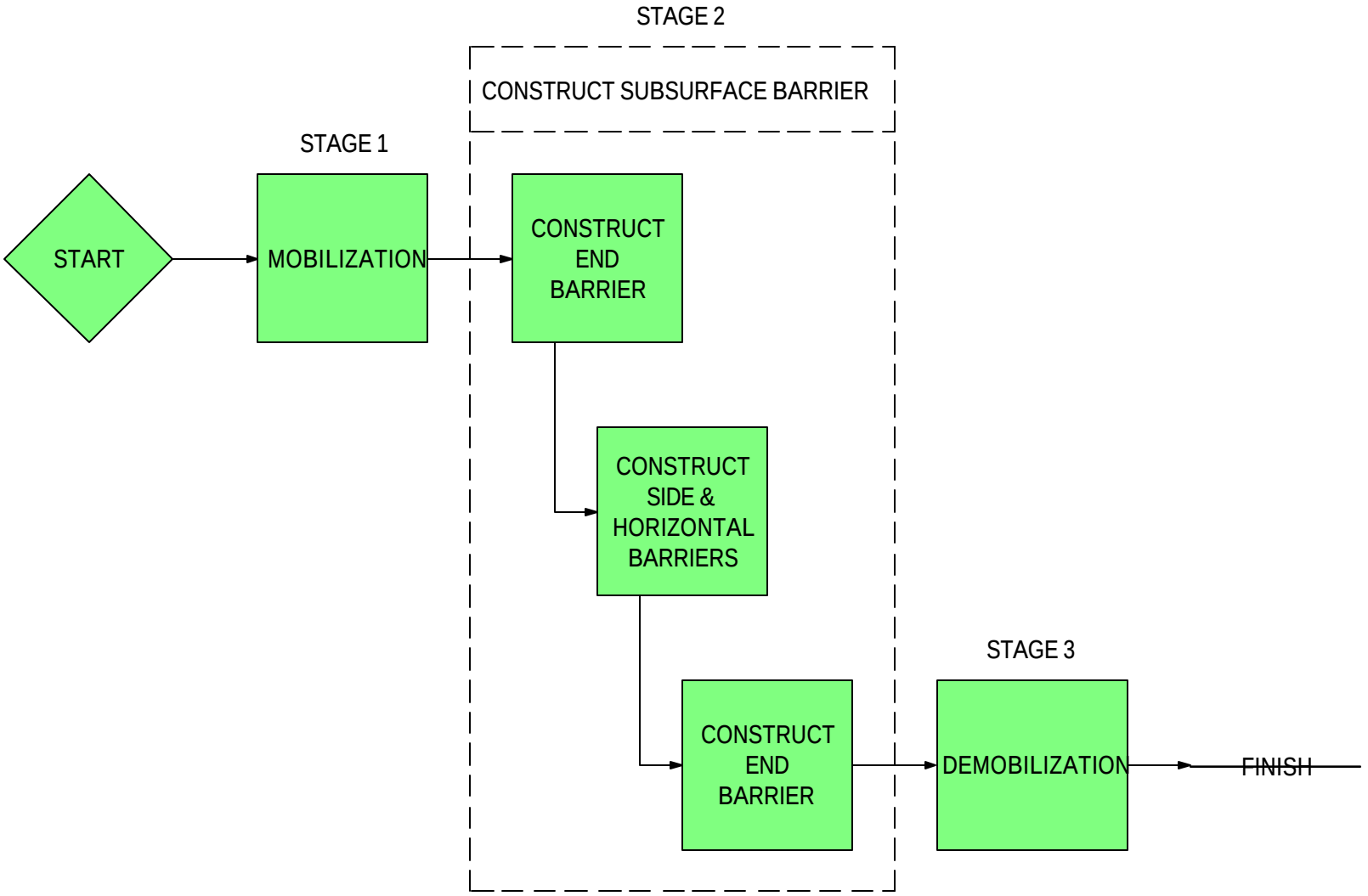
CONSTRUCTION MATERIAL

SUBSURFACE CONTAMINANTS FOCUS AREA



- 3000-psi Concrete
- Standard Rebar

CONSTRUCTION PROCESS

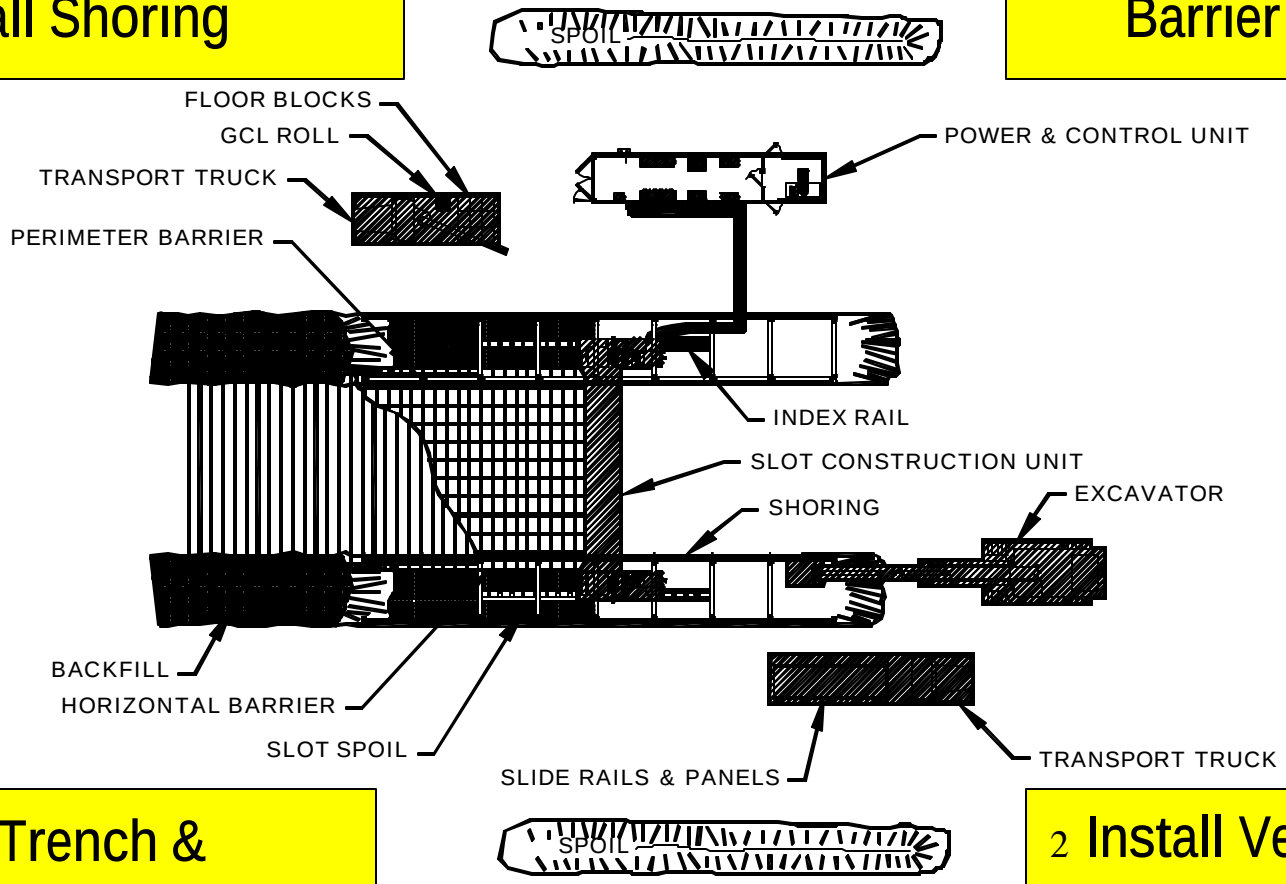


Stage 2: Construct Subsurface Barrier

SUBSURFACE CONTAMINANTS FOCUS AREA

2 Excavate Trench & Install Shoring

2 Construct Horizontal Barrier

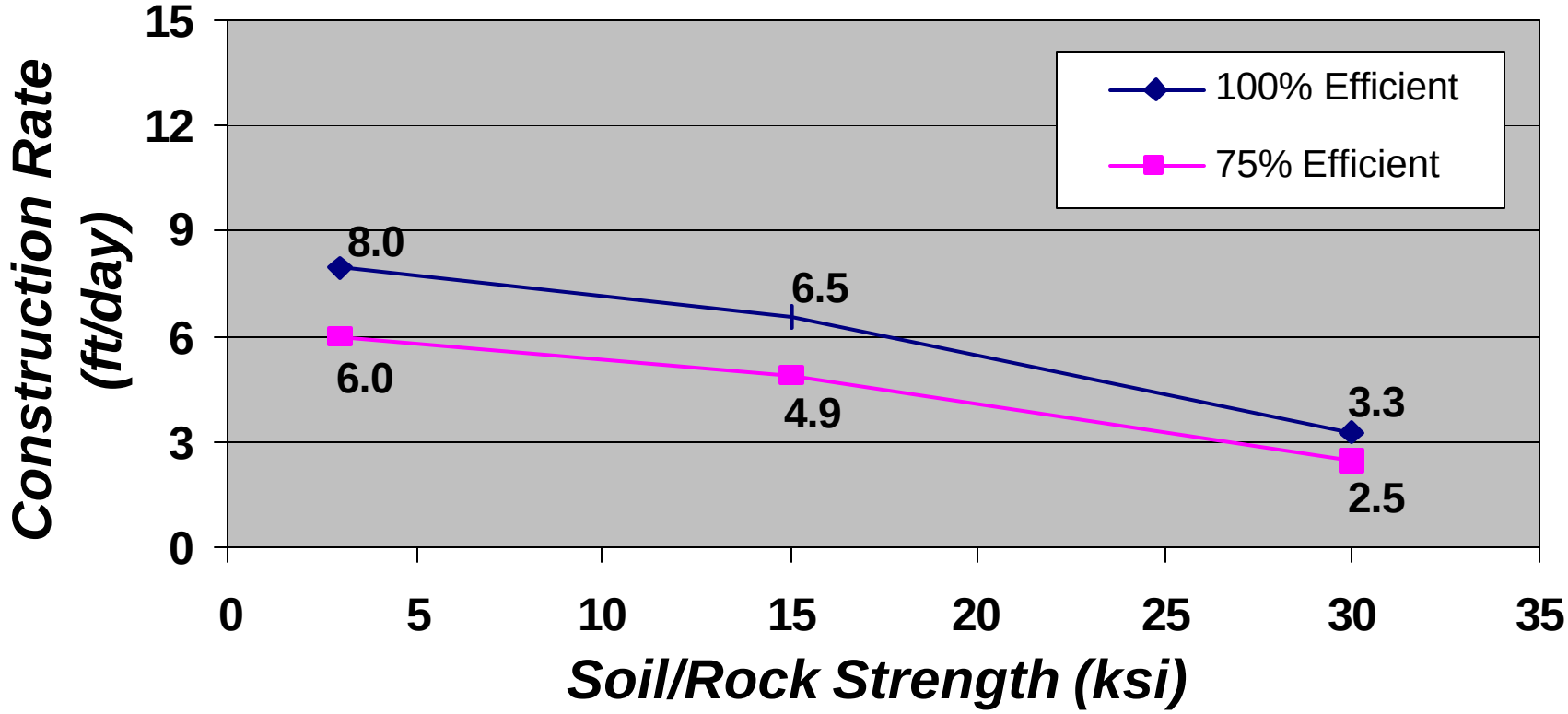


2 Backfill Trench & Remove Shoring

2 Install Vertical Barrier

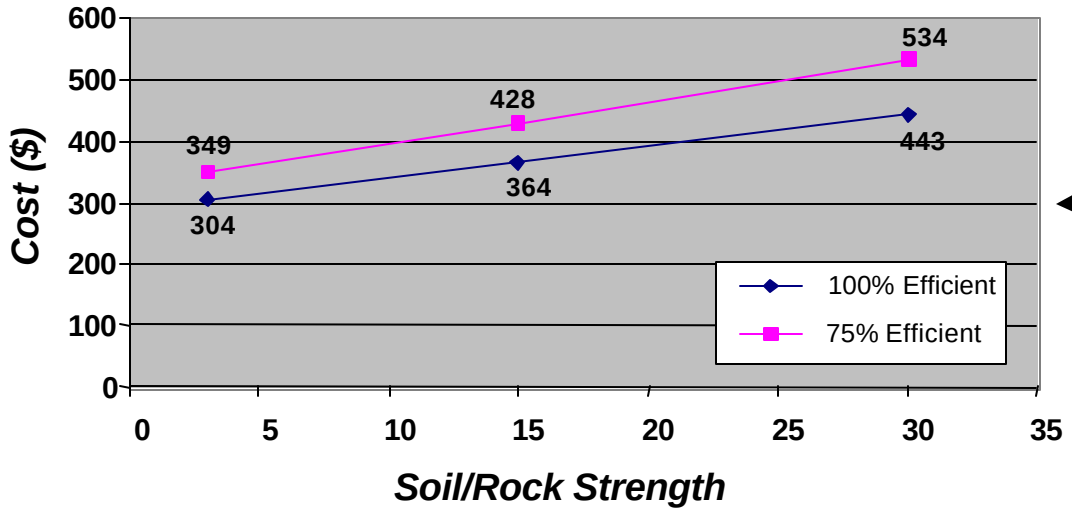
Construct Subsurface Barrier

Construction Rate



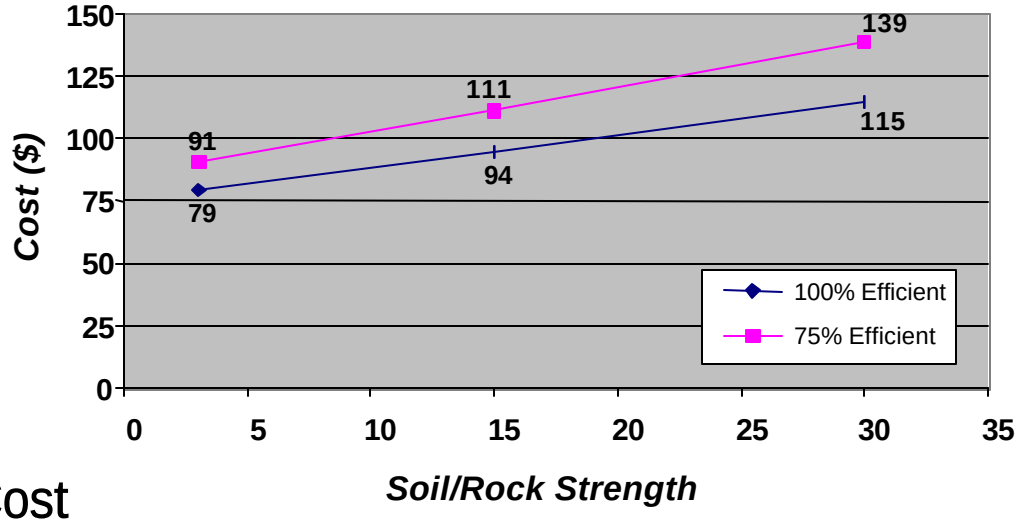
- 1000-ft Long X 35-ft Wide X 29-ft High Barrier
- Includes Mobilization & Demobilization Time
- 8 hr/day Operation

Construction Costs



Cost/Cubic Yard
of Waste Contained

Cost/Square Foot
of Placed Barrier



- $100,000 Mob/Demob Cost Each
- $6.75/sq ft RCRA Cover Cost
- $2.0 Million Long-Term Monitoring Cost

Test Objectives

- Verify Safe Operation
- Verify Equipment Design Principles
- Validate Functional Performance
- Obtain System Performance Data

SCU Factory Test

Shoring Installation Test

TRENCH EXCAVATION & SHORING INSTALLATION

SCU Performance Test

HORIZONTAL BARRIER CONSTRUCTION

SCU Performance Test

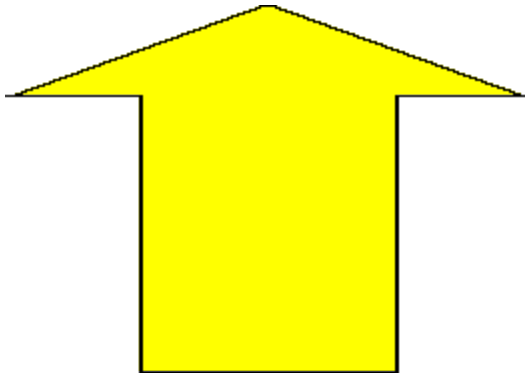
HORIZONTAL BARRIER CONSTRUCTION

Test Summary

- Conducted Safe Operations
- Validated Operating Procedures
- Verified Shoring System Feasibility
- Demonstrated Slot Excavation Method
- Successfully Installed Horizontal Barrier
- Established Construction Timelines & Operating Crew

BENEFITS

- Reduces safety and health risks to site workers and the public.



- Provides a low-cost reclamation alternative.
- Minimizes near-term site reclamation activities.
- Provides an interim solution until treatment options and ultimate disposal sites are resolved.